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ABSTRACT

Methane gas is migrating underground from the landfill to the north of the facility. To prevent the gas from migrating off site, a gas collection/barrier system will be required. Due to the depth of the gas involved and cost of aggregate materials in the area, a passive barrier system, such as a cutoff trench is not considered economically feasible. Therefore, a vacuum system utilizing vapor extraction wells has been selected as the most viable option to remediate the landfill gas migration.

Using testing and data compiled by Lawrence and Associates, a gas extraction system consisting of regularly spaced extraction vacuum wells and a pumping system has been designed. The following design report outlines the assumptions and recommendations to prevent off-site migration of landfill gases from this site.

WELL SPACING

Data taken from Lawrence and Associates report titled "Results of Well Installation and Gas-Drawdown Testing for a Perimeter Gas-Collection Barrier at the Anderson Solid Waste Landfill" and dated "September 10, 1991" (Attachment C) indicates the outer boundaries of the gas migration to the east and west of the northern property line. Wells placed beyond the indicated extent of the migration have been tested at non detectable levels of methane. In order to assure that a vacuum barrier system is effective, wells must be placed sufficiently close together to prevent voids in the vacuum barrier. Vacuum and flow testing, as shown in Figure 25 of Attachment C, shows that each well has a radius of influence of approximately 200 feet. Since the waste material is located a distance of approximately 100 feet from the wells, well spacing will need to be kept to a maximum of 100 feet to assure that methane gas is not pulled from the landfill in excessive amounts. This will also provide a safety factor of at least 2 in assuring that the gas does not find a way to migrate between the extraction wells. At the terminal ends of the system, extraction wells will be placed consecutively at 100 foot intervals until a well tests at non detectable methane levels. This will provide an accurate boundary delineation and prevent unneeded wells from being placed in the system.

VACUUM AND GAS FLOW

Pumps and piping must be sized according to the vacuum required and total flow expected from all the wells. From Figure 26 of Attachment C, the highest observed pressure differential between the landfill and the proposed barrier at 50 feet was 0.35 inches of water. The flow at this point is approximately 0.7 cfm. From Figure 25 of Attachment C, 0.7 cfm at 100 feet from the well shows a total discharge from the well of approximately 15 cfm. From Figure 24 and a well discharge of 15 cfm we see that 60 inches water is the amount of vacuum necessary to maintain this flow rate. Twenty-six wells are estimated to be necessary at 100 foot spacing to complete the extraction system. This will require a pump capable of moving 390 cfm at a vacuum of 60 inches of water. The vacuum pump proposed is a Lamson Turbotron Exhauster rated at 550 cfm at 78 inches of water using a 3,500 rpm direct drive 15 hp motor. This will allow for additional wells to be added, if necessary, or fine tuning deviations in the system that may be required during system start-up.

GAS MANIFOLD AND WELL SYSTEM

A gas manifold pipe eight inches in diameter shall connect each of the 26 estimated wells to the vacuum pump system. The wells shall be placed at 100 foot intervals and constructed as detailed by Lawrence and Associates, Attachment C, for depth and construction. Each well will be two inches in diameter and the well head placed in a two foot cubicle concrete vault with a steel or aluminum lockable lid. The wells will be connected to the gas manifold using a two-inch ball valve inside the vault and piped to the eight-inch manifold where it will be attached using a two-inch saddle. The maximum distance from the well to the gas manifold shall not exceed 15 feet. This is to prevent excessive line (vacuum) loss through the two-inch pipe.

SAFETY AND RELIABILITY

The vacuum pump system shall consist of two pumps: one pump to be in operation at all times for operation of the vacuum system with the other pump being provided as a backup (see Attachment A, Design Plans). Each of the pumps will be fitted with exhaust silencers and flame arrestors. An in line filter shall serve both pumps and act as a condensate trap. The pumps and filter will be located inside a fenced enclosure with a locking gate. Since the site is monitored on a daily basis, manual controls are proposed for the system. This will increase the reliability of the electrical system and will minimize the potential of down time caused by potentially greater and more complicated malfunctions in an automatic system. A manual system also assumes regular monitoring by the system's operators. A flashing red signal light triggered upon a pump failure can be installed if it is found necessary. A manual system is considered adequate since a 24 hour period of down time should not be long enough for gas to begin migrating off site.

Additionally, extraction wells shall be placed between the landfill and the office structure reducing any potential problem from gas migrating the enclosed structures.

METHANE DISCHARGE PERCENT AND VOLUME.

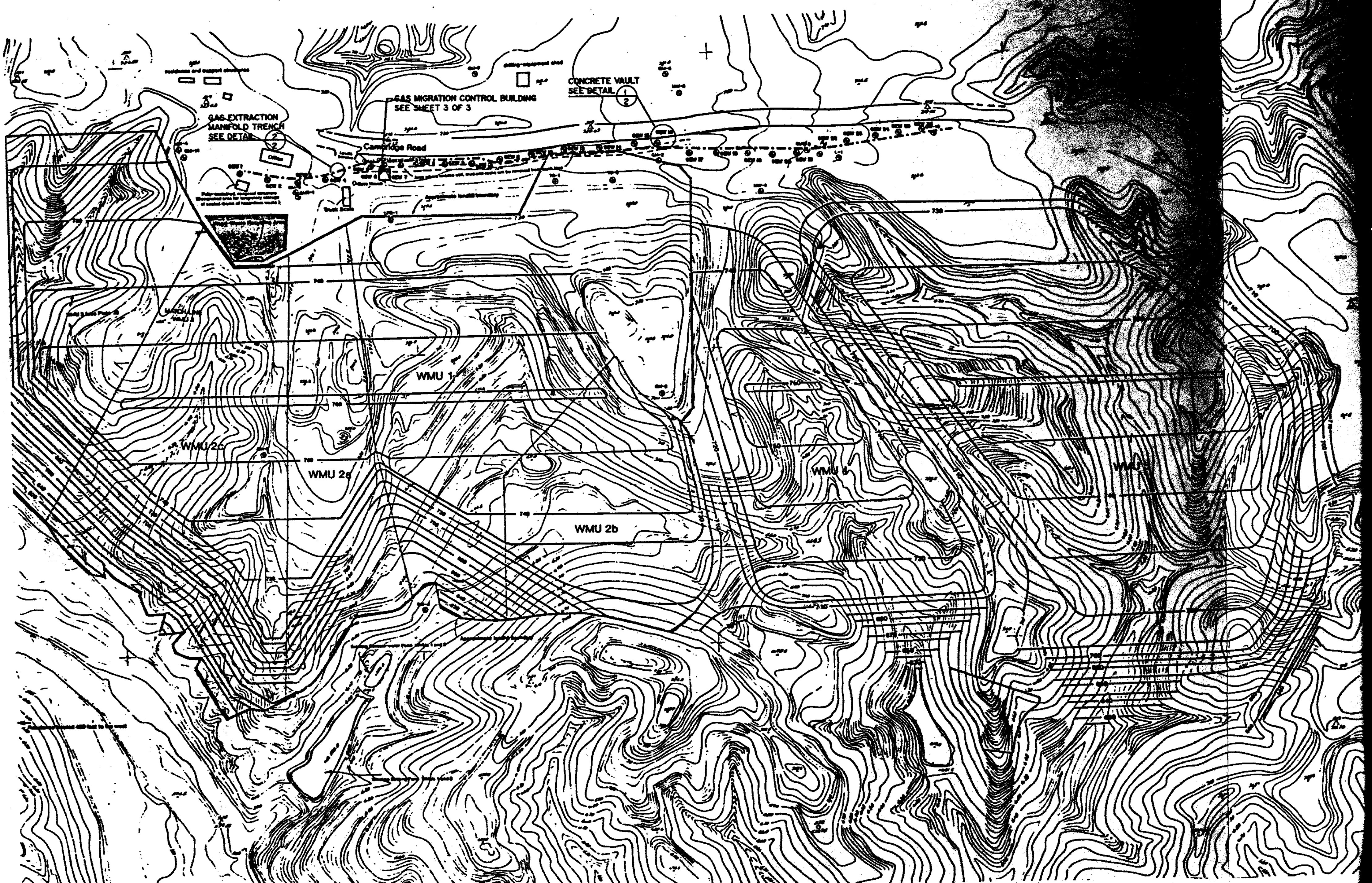
Methane discharge is expected to be two percent by volume or less after stabilization (Lawrence and Associates, Page 18, Attachment C). This value is considered conservative since most barrier systems presently in operation are producing gas levels of less than one percent. Infiltration of air into the landfill will reduce gas generation by destroying the anaerobic bacteria. Additionally, air will be pulled from the surrounding soils further diluting the gases produced by the landfill. When the system is balanced, gas rates can be expected to be below projected rates due to the inevitable increase in oxygen in the landfill. The only way to prevent this is to have the landfill capped and surrounded by an impermeable layer and allow the gas to collect under its own pressure.

The expected volume for discharge will vary according to the vacuum placed on the system and the transmissivity of the adjacent soils. During and after rainstorms or freezing weather, the volumes will decrease significantly as the vacuum increases. During long periods of dry spells, the volume will increase as the soils dry out. Although barometric pressure will have a slight effect on the system, it will be negligible due to the relatively high vacuum being placed on the system.

ATMOSPHERIC VENTING VERSUS FLARING

At present, it is proposed that the system be vented directly to the atmosphere. Because of environmental safety concerns, it has been suggested that the discharge gas should be flared to destroy the methane present in the discharge gas. Flaring a mixture of two percent methane gas and air is not feasible. For methane to burn it must be at least five percent of the total methane/air mixture. As an open flare, a 5 percent to 15 percent mixture of methane in air is a dangerous combination since it tends to backflash through the system, and even flame arrestors have been known to fail when constantly subjected to a flame. In order to effectively burn the gas, a sufficient amount of fuel would need to be added to assure a complete and continuous burn. The most practical gas to add in most localities is natural gas, with propane being a second choice. The theoretical minimum additional natural gas needed to flare the landfill gases is one and one-half times the amount of methane at the two percent presently estimated. State of the art enclosed ground flares presently require a minimum of 20 percent methane or natural gas in the supply stream in order to maintain combustion temperatures and a continuous flame. Therefore, under such an operation, we would actually need to add nine times the amount of natural gas to our extracted two percent methane gas in order to operate the flare. From an environmental standpoint, the additional carbon dioxide discharged would be expected to have a much higher impact on global warming than the methane that the landfill would ordinarily release, and it would additionally consume a valuable non-renewable resources in the process. Allowing the discharge of methane at a level of two percent or less will keep the potential ignition of the gas below a safe level, and the dissipation to the atmosphere will quickly dissipate the discharge to non-detectable levels.

At two percent methane and an extraction rate of 400 cfm, the methane which would be discharged (8 cfm) would, by most landfill standards, be a minor amount of discharge.



GAS EXTRACTION
MANIFOLD TRENCH
SEE DETAIL
GAS MIGRATION CONTROL BUILDING
SEE SHEET 3 OF 3
CONCRETE VAULT
SEE DETAIL
Cambridge Road
WMU 1
WMU 2c
WMU 2a
WMU 2b